Address on the Occasion of Dr. Lederberg's 80th Birthday

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I am honored to speak about Josh Lederberg on the occasion of his eightieth birthday. It has been my great privilege to have 45 years of joint efforts and deep friendship. Let me start with a citation for his achievements written three decades after his Nobel. In 1989, our nation's highest honor in science and technology, the National Medal of Science, was awarded to him with a concise and illuminating citation: Joshua Lederberg:

"for his work in bacterial genetics and immune cell single type antibody production; for his seminal research in artificial intelligence in biochemistry and medicine; and for his extensive advisory role in government, industry, and international organizations that address themselves to the societal role of science."

I could add much more—and will, to some extent. All of us here are familiar with his truly great scientific achievements and distinguished

creative leadership at Rockefeller University. So I will try to add a few perspectives that are perhaps not as well known as they should be.

How did all of this happen? In childhood, he had prodigious intellectual gifts, along with a reverence for learning and scholarship—powerfully reinforced by his family.

From then on, his life has been characterized by boundless curiosity—a fresh look at everything.

He has taken deep satisfaction in discovery—and then raising the next question—and the next, and, indeed, the next twenty questions. This inter-related set of attributes has characterized him all his life and has much to do with his great accomplishments.

One dramatic feature of his career: he was a school dropout—medical school, that is. He entered medical school with his typical intense curiosity and sense of discovery. This was a learning moment; and he shifted to graduate school in biology to pursue the frontiers of knowledge. There began a line of inquiry that led to the Nobel prize.

This was ground-breaking, highly imaginative work on nature of micro-organisms, especially their mechanisms of inheritance. He opened

up bacterial genetics, including the momentous discovery of genetic recombination. This work was one of the crucial foundations for subsequent exploration and discovery of cellular and molecular biology; so many of us stood on his shoulders and he helped us get there.

He won the Nobel prize at age 33 in 1958. One of the youngest in any field, from any nation.

Another attribute is his remarkable capacity for Institutional innovation. He created a Department of Genetics in the Medical Schools of Wisconsin and Stanford. Until then, genetics had been marginal—or non-existent—in medical schools. There was a widely shared assumption in the middle of the twentieth century that genetics might be intrinsically interesting, but that it would never have much practical significance for medicine. How wrong that assumption was!

While actively stimulating and fostering basic research, Josh also sought applications—and helped to create the biotechnology industry. In teaching and in "institution building" he emphasized the mutually beneficial interplay of science and clinical research.

In this context, he was very generous in helping to establish new clinical departments and new kinds of clinical departments. At Stanford, he helped with psychiatry, pediatrics, medicine, and neurology. He often inspired us with the classic experiments of Avery, McLeod, and MacCarty at Rockefeller University in the 1940s. Their clinical inquiry into pneumonia led to the great discovery on a most basic level: DNA is the genetic material. He helped us to build on basic components and to create interdisciplinary groups. He also helped us to identify research opportunities and promising lines of inquiry and innovation.

He has been a mentor to many of us. The world is full of people grateful to Josh for his powerful insights, creative suggestions, and generosity of spirit.

Within his own remarkable department he fostered many lines of inquiry: molecular genetics, cellular genetics, clinical genetics, population genetics, exobiology (NASA's Mariner and Viking missions to Mars), immunology, and neurobiology.

He always had a world-wide view, and brought in superb people, not only from the mysterious east of the US, like New York City-but also,

e.g., W. Bodmer (UK), Luca Cavalli-Sforza (Italy), Gus Nossal (Australia), Eric Shooter (UK), and others from afar—all major contributors His global outlook, long-term vision, intense curiosity, and unfailing kindness inspired all of us seeking to create new kinds of clinical departments.

Thus, his rare capacity to range widely with open eyes and open mind—and also dig deeply into a specialized topic and to combine these capacities in research, education, and intellectual synthesis—led to intellectual stimulation of many others in a variety of fields and nations.

His knowledge, curiosity, and imagination have been expressed in many ways. For example, he was instrumental in the creation of a highly innovative undergraduate major at Stanford, now marking its 35th year as one of the most sought after majors at that University. It is broadly integrative across the life sciences, linking basic science, hands-on experience (including field research), biological aspects of behavioral science, and, in the senior year, applications of the life sciences to policy (e.g., in health and environmental problems).

Early in the computer era, his interest in computer science grew, and he became a pioneer in artificial intelligence, especially in relation to biochemistry, genetics, and medicine.

He believes deeply in education of the broad public, opening complex and emotionally charged topics for informed public discussion.

He was a pioneer in the scientific assessment of human impact on the environment—and especially on health implications of environmental conditions.

One major vehicle was a column in *Washington Post* during the 1970s, in which he interpreted science for the public and for several years produced fascinating, highly informative columns.

All of this rich experience, knowledge, skill, and wisdom was brought to bear on Rockefeller University under his presidency. You all know that story of remarkable accomplishment; all of us here have benefited. But I want only to emphasize one aspect that I perhaps know better than most. For years I was chair of the Scientific Affairs Committee and so spent much time with Josh on faculty matters. His deep respect

and concern for the well-being of faculty—young and not so young—was remarkable. This was a crucial aspect of his leadership.

Josh was a pioneer in biological warfare and bioterrorism, applying his creative mind and far-sighted vision in efforts to understand the danger and find ways to cope with it. He strongly influenced negotiation of the biological weapons disarmament treaty.

He has advised the US government in many agencies: the NIH, NSF, NASA, Navy OSTP, and others. On the world stage, he was an intellectual leader for years of the World Health Organization's Advisory Committee on Medical Research.

He was Co-Chair of the Carnegie Commission on Science, Technology, and Government, producing multiple publications on most branches of government.

Altogether, I know of no eminent scientist who has given so much serious analysis of public policy and social problems. It is not too much to say that our country and the world are in his debt.

So, Josh and Marguerite (who has been such an inspiration and support), we here tonight are your <u>deep</u> and <u>enduring</u> friends. We

profoundly appreciate what you have done—so very much for so many—indeed, for humanity.

So, those of us who know you best salute you tonight, wish you the very best in the years ahead, and profoundly respect your great legacy.